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ABIES
(*firs*)

F—490515

There are about 40 species of true firs (*Abies*), all native in the Northern Hemisphere. They grow in cool temperate regions and mountains southward to Guatemala, northern Africa, Himalayas, and Taiwan. Seven of the 9 species in the United States are important in forestry.

The trees usually have bark with resin blisters, afterwards usually furrowed. Fir needles are usually flattened or sometimes 4-angled, pointed or notched and are often spreading in 2 rows. They persist for 7 to 10 years.

Male and ovulate strobili develop on the same tree in spring from buds formed along twig growth of the previous year. The upright cylindrical or egg-shaped cones, mostly on topmost branches, mature in one season. They are composed of very many closely overlapping, thin scales. The seeds, usually paired at base of a scale, have broad wings and contain resin cavities. After the cone matures, the scales fall off, while the upright central axis remains on the twig through the winter. Cotyledons usually 5 to 7.

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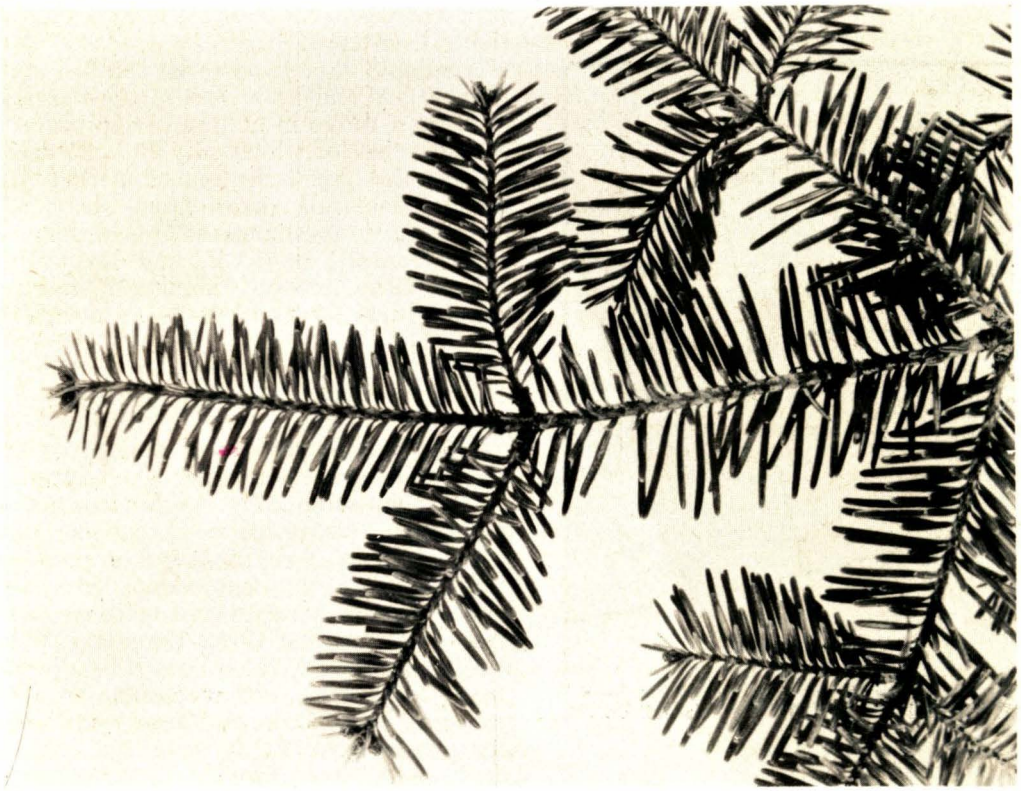


NOBLE FIR (*Abies procera* Rehd.)

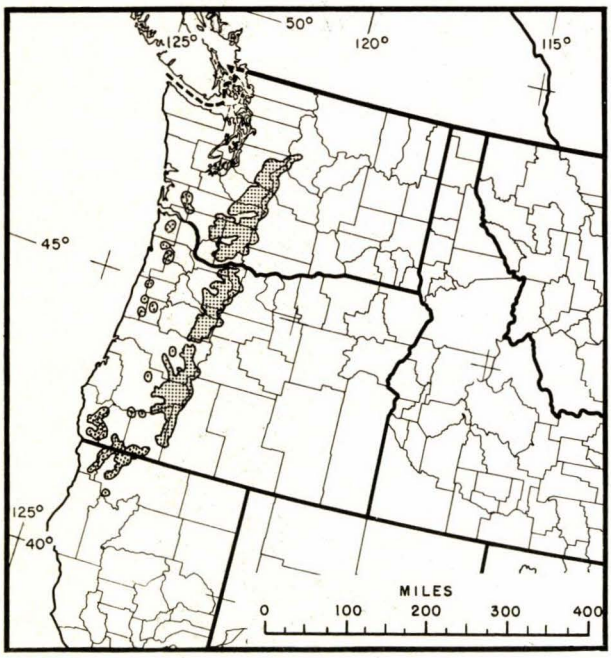
Other common names: Red fir, white fir.

Noble fir is native to the Pacific coast from Washington to northern California. This species is most abundant on the west side of the Cascade Range although it grows on the east side of the summit throughout its latitudinal range. It also appears sporadically on higher peaks in the Coast Ranges of northwestern Oregon and in the Willapa Hills of southeastern Washington.

Exact limits of the tree's range are still unknown, and conflicting reports are more the rule than the exception. Distributions based on early explorations show the tree as occurring on the slopes of Mount Baker. Botanists who more recently have made detailed studies of the area either state they did not find any noble fir (*25*)[1] or do not mention it (*29*). The northernmost noble fir now known grows in the Stevens Pass Area and Rainy Creek drainage of the Little Wenatchee River. The trees in these outliers are vigorous, and the species may occur farther north. Early reports also indicated that the tree grew in the Olympic Mountains but a later observer was unable to confirm its presence anywhere in the Olympic Peninsula (*21*). Paleobotanical evidence (*13*, *14*) indicates that noble fir probably did occur in the Olympics and north Cascades in the past.

The situation is even more confused in southwestern Oregon and northwestern California as a result of the merging of noble fir with the taxonomically and ecologically similar Shasta red fir and California red fir. Noble fir is reported not to grow in the Crater Lake Area (*2*) and it is believed most of the trees in southwestern Oregon are red fir (*16*). Other workers, who also made detailed studies here, disagreed and felt most of the trees in this region were noble fir (*23*, *34*, *36*).

[1] Italic numbers in parentheses refer to Literature Cited, p. 29.



F–506563

The range of noble fir.

HABITAT CONDITIONS

Climate

The range of noble fir lies almost entirely in the superhumid climatic zone but some trees extend into areas classed as humid. Generally, the climate is characterized by short, cool growing seasons with low growing season rainfall, but abundant annual precipitation. In the Coast Ranges, much of the precipitation occurs as rainfall, whereas in the Cascade Range, a high proportion falls as snow.

Available data from seven selected stations between 1,500 and 4,000 feet in the Cascade Range indicate a range in annual precipitation from 70 to 103 inches, of which only 20 to 25 percent falls during the April–September period (table 1). Annual snowfall varies from about 80 to 480 inches. Average temperatures during January range from 24° to 35° F., and during July from 57° to 62°. Absolute maximum and minimum temperatures for six of the seven stations are 105° and −17°.

Soils and Topography

Noble fir will grow on a wide range of soils if ample moisture is available; water supply is more critical than soil quality. Since it is not an exacting species, trees will reach commercial size on relatively poor, rocky, thin soil on mesic sites.

Noble fir grows almost exclusively on soils derived from sedimentary and volcanic rocks in the Cascade Range and Coast Ranges. In the Siskiyou Mountains it occurs on soils derived from peridotite, gabbro, and serpentine on more moist sites, and on soils derived from quartz-diorite on dry to moist sites (*34*).

TABLE 1.—*Climatological data for selected stations between 1,500 and 4,000 feet elevation in Oregon and Washington*

Station and altitude (feet)	Average precipitation			Temperature					Frost-free period
				Average			Absolute		
	April–September	Annual	Annual snowfall	Annual	January	July	Maximum	Minimum	
	Inches	*Inches*	*Inches*	*Degrees F.*	*Degrees F.*	*Degrees F.*	*Degrees F.*	*Degrees F.*	*Days*
Washington:									
Snoqualmie Pass (3,020)	21	95	386	42	26	58	101	−17	
Cedar Lake (1,560)	29	103	79	49	35	62	98	−11	201
Longmire (2,762)	19	77	168	45	30	61	105	−8	134
Spirit Lake (3,240)	20	86	239	42	30	59	97	−15	136
Stampede Pass (3,963)	22	94	483	40	24	57	86	−11	
Oregon:									
Government Camp (3,890)	22	85		42	30	56	96	−16	
Sundown Ranch (2,350)	18	70		48					

Noble fir is essentially a tree of the mountains. In the Cascade Range the bulk of the noble fir is found in the Canadian Life Zone, lying between 3,000 and 5,000 feet on Mount Rainier, 3,000 and 6,000 feet on Mount Hood, 4,500 and 7,000 feet on Three Sisters Peaks, and 5,000 and 7,200 feet on Mount McLoughlin (central Washington, northern, central, and southern Oregon Cascade Range, respectively (*3*, *8*)). In the northwestern Oregon Coast Ranges most noble fir is found above 3,000 feet on higher peaks. It has beeen reported as low as 500 feet elevation on the Grays River-Skamokawa River Divide in southwest Washington (*10*) and 200 feet elevation near Newport, Oreg., and as high as 8,800 feet near the southern limit of its distribution (*23*).

Associated Trees and Shrubs

Noble fir is associated with most other Pacific Northwest conifers at some point in its range. Most commonly these are Douglas-fir, Pacific silver fir, western and mountain hemlocks, western white and lodgepole pines, and western redcedar. It is also found growing with grand, subalpine, and white fir; Engelmann, Sitka, and Brewer spruces; western larch; whitebark pine; and Alaska cedar.

Noble fir is a minor component of five forest cover types, occurring in greatest amounts in the Pacific Silver Fir—Hemlock Type (Type 226). At high elevations noble fir often forms an important part of this forest type. Noble fir occurs also in these types: Mountain Hemlock—Subalpine Fir (Type 205), Western Hemlock (Type 224), Pacific Douglas-Fir (Type 229), and Douglas-Fir—Western Hemlock (Type 230). In southern Oregon, the Pacific Silver Fir—Hemlock Type merges into the Red Fir Type (Type 207). In the resulting transition zone noble fir and California red fir overlap.

Shrubs found in association with noble fir are typically those characteristic of the Canadian Zone. They include rusty menziesia (*Menziesia ferruginea*), Cascades azalea (*Rhododendron albiflorum*), Coast rhododendron (*R. macrophyllum*), red whortleberry (*Vaccinium parvifolium*), ovalleafed whortleberry (*V. ovalifolium*), Grouse whortleberry (*V. scoparium*), Alaska blueberry (*V. alaskensis*), big whortleberry (*V. membranaceum*), woolly raspberry (*Rubus lasiococcus*), Myrtle pachistima (*Pachistima myrsinites*), and several species of wild currant (*Ribes* spp.).

LIFE HISTORY

Reproduction and Early Growth

Flowering and fruiting.—Observations at 3,800 feet elevation on the north slope of Marys Peak (Oregon Coast Ranges) in 1961 revealed the following information about noble fir:

Male bud bursting	May 14–May 23
Female bud bursting	May 20–May 30
Vegetative bud bursting	May 30–June 15
Pollen shedding	June 12–June 18
Seed dispersal	Oct. 8–Oct. 18

Observations of noble fir development during the same year indicated about the same phenology at 3,500 feet elevation on Larch Mountain in southwestern Washington (Clark County) and 5,000 feet elevation on Carpenter Mountain in central western Oregon (Lane County). Development lagged by 5 to 10 days at 4,800 feet elevation on Frog Lake Butte in northern Oregon (Wasco County) and at 6,300 feet elevation on Dutchman Peak in the Siskiyou Mountains (Jackson County). The spring of 1961 was about normal throughout this area.

In 1956, bud bursting of noble fir took place between May 12 and May 15 at 3,500 feet elevation on Larch Mountain in southwest Washington (Clark County).[2] This took place several days earlier at 2,500 feet. The 1956 spring should be characterized as normal or slightly early. In 1957, noble fir at 4,500 feet elevation in King County, central western Washington, shed pollen during the week of May 27.[3]

Seed production and dissemination.—Cones complete their external growth in early August, ripen in September, and disperse their seed in October. Trees 20 to 30 years old may bear cones although seed bearing is generally considered to begin at 50 or 60 years. One tree may produce over 500 cones during a good seed year; one tree was observed which produced over 800. Good seed crops are borne infrequently, although some seed is produced every year.

The seed is comparatively heavy, averaging 14,600 per pound. In seed flight studies (*19*), 73 percent of the winged seed released at 200 feet in an 11-m.p.h. wind fell 1,400 feet or less from the point of release, with greatest fall, 21 percent, at 1,400 feet. Maximum seed flight was 2,200 feet. These distances are about the same as for Douglas-fir. Seed recovered at 1,400 feet was of about average soundness, whereas that recovered at greater distances was less than average.

Cones and seeds are attacked by a cone moth (*Dioryctria abietella*), a seed chalcid (*Megastigmus pinus*), and several species of seed gall midges including (*Dasyneura abiesemia*). Much of the unsound seed found in noble fir is probably sterile, not the result of insect damage. Developing cones, up to the time they are 3 to 4 inches long, may be killed by late frosts or by mining of their bases by cone moths (*Dioryctria* spp.). Large quantities of cones and seed may be taken by squirrels or other rodents. However, observations made in the Oregon Coast Ranges indicate rodent preference for Douglas-fir seed is high in comparison with noble fir seed (*11*).

Seedling development.—Noble fir seed has low germinative capacity and is of transient vitality. At one time it was thought that noble fir reproduced from seed stored in the duff, but it has since been shown that noble fir seed remains viable for only one season in the forest floor (*20*). Noble fir seeds germinate freely and seedlings grow well in the open or in moderate shade on any moist humus or mineral soil (*15*). Initial seedling development is very slow. Seedlings are normally ¾ to 2 inches high at the end of the first growing season, and require at least 3 or 4 years to reach a height of one foot (*15*).

The main root of noble fir is slow growing, whereas lateral roots develop rapidly and have few branches (*35*). Root systems of typical 1- to 3-year-old seedlings are not fibrous in appearance and do not have a well-developed tap root. Failure to develop an early tap root may explain why seedlings survive only in moist soils.

Planted seedlings make very slow initial growth. In one study (*33*), noble fir seedlings were only 0.28 feet tall at the end of the first growing season, less than half the height of Douglas-fir seedlings planted at the same time. However, damage to the noble fir seedlings, particularly from browsing, was much less than to the Douglas-fir.

Competing vegetation may deter noble fir regeneration on certain habitats. Regeneration was observed to be sparse on some small clear cuts near Mount Rainier despite a high proportion of noble fir in the adjacent stands. This was attributed to a dense mat of sedges on the areas in combination with snow accumulations and deer trampling which flattened the mat during the winter.[4] Dense growths of big whortleberry (*Vaccinium membranaceum*) and common beargrass (*Xerophyllum tenax*) on old burns have been observed to significantly reduce the survival of planted noble fir seedlings.

In the high altitude range of the species, snow often covers the ground before seed is dispersed. Some seed may germinate in the snowbank the following spring (*31*). Such seedlings have little or no chance for survival, but apparently the phenomenon is not sufficiently common to seriously hinder natural regeneration.

Sapling Stage to Maturity

Growth and yield.—Noble fir is a slow starter in relation to associated species. Seedlings require 3 to 4 years to reach a height of 1 foot, and 11 years to reach breast height (*15*). Following the juvenile stage, however, height growth is rapid and the tree is able to compete with its associates. Noble fir in mixed stands always composes part of the upper-crown canopy. It often extends above the average level of the crowns of associated species.

A study in a 400-year-old mixed stand of Douglas-fir, western hemlock, and noble fir showed that dominant trees of all species followed about the same diameter growth pattern (*15*). When 120 years old the trees averaged about 24 inches

[2] Statement from Charles Briggs, Wash. State Dept. of Nat. Resources.

[3] Statement from John Rediske, Weyerhaeuser Timber Co., and John Duffield, Indus. Forestry Assoc.

[4] Boardman, Robert. A preliminary investigation into the habitat and ecological factors present in true fir-hemlock types growing on the western slopes of the Washington Cascade Range. Typewritten report submitted to Dr. D. R. M. Scott, Assoc. Prof. of Silvic., Univ. of Wash., Col. of Forestry.

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in diameter. Initially the associated species grew at a greater rate, but noble fir overtook and surpassed them between 100 and 200 years. The growth pattern of noble fir was:

Age (years)	*D.b.h. (inches)*	*Height (feet)*
120	23. 6	111
200	32. 2	146
300	42. 1	176
400	49. 4	196

Noble fir is probably the longest lived of the true firs, but its extreme age is unknown. The largest tree on record is 87 inches in diameter and 260 feet tall (*1*). Trees approaching this size are undoubtedly 600 to 700 years old.

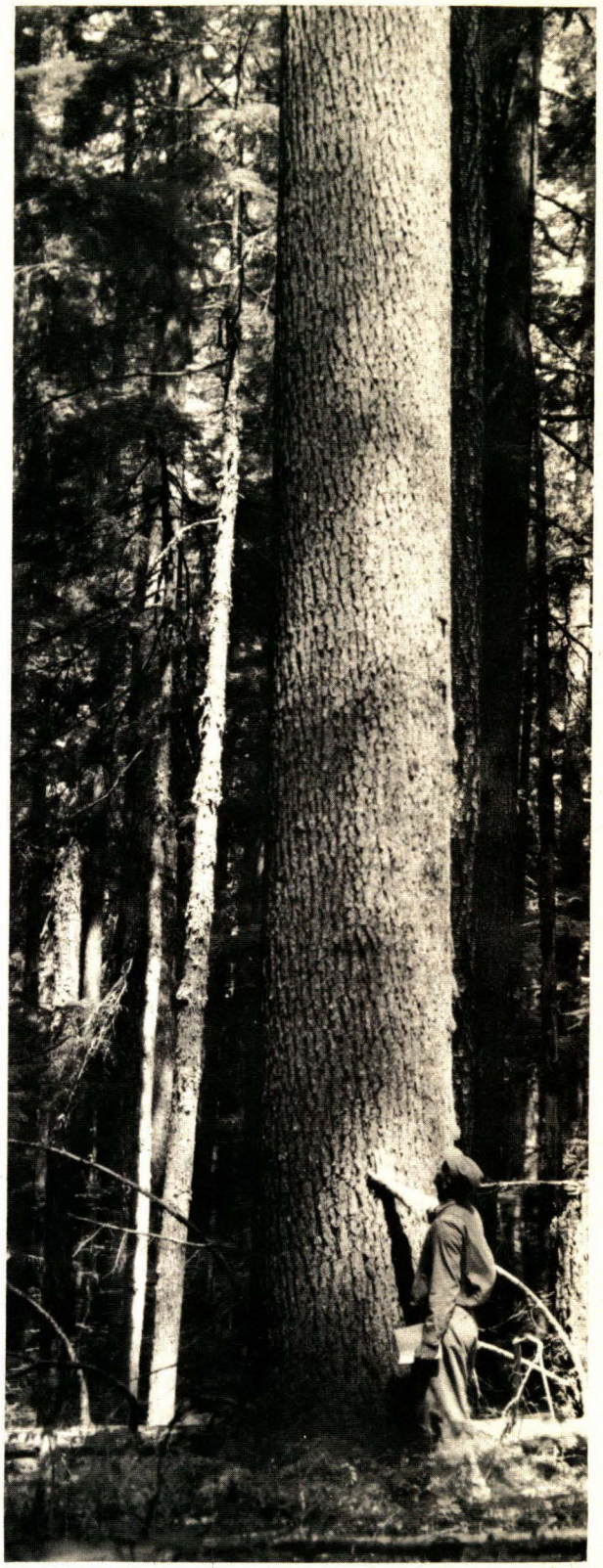
The bulk of the noble fir volume is found in mixed stands, mainly in the Pacific silver fir—western hemlock and Douglas-fir types, but little yield information is available. In a 400-year-old Douglas-fir—western hemlock—noble fir stand, average yield per acre was 141,110 board feet (*15*). Noble fir numbered less than 20 percent of the trees, but made up almost half of the volume, 69,415 board feet per acre.

An analysis of 11 timber sales covering 3,056 acres on the Snoqualmie National Forest in Washington, mostly in the Pacific Silver Fir—Western Hemlock Type, showed that the stands averaged 49,500 board feet per acre. Noble fir made up from 20 to 44 percent of the stands by volume, averaging 28 percent. On one sale of 35 acres, the cut averaged 108,600 board feet per acre, of which 38 percent was noble fir. These stands were all estimated to be from 250 to 300 years old.

Noble fir, because of its high form factor and thin bark, has a greater volume per tree at breast height than any of its associates (*15*).

Reaction to competition.—Noble fir is classed as an intolerant tree by most authors (*4*). Unlike other *Abies* species it is not usually found as a subdominant in established stands because it is so light demanding that reproduction often does not survive under older stands even in the juvenile stage. It needs about the same amount of light as Douglas-fir for reproduction (*15*).

The question of its tolerance is not so clear-cut as it might seem, however. In a study conducted on Marys Peak in the Oregon Coast Ranges noble fir was well represented in all size classes from seedlings to trees 48 inches d.b.h. and 150 feet tall in a western hemlock—noble fir—Douglas-fir stand growing on the north slopes and in a Douglas-fir—noble fir stand growing on the south slopes (*24*). Noble fir was considered codominant and climax in both stands. Another investigator (*26*) working above 2,000 feet elevation in the Oregon Coast Ranges also found the species in all size classes from seedlings to 60-inch d.b.h. trees. Here, however, the smaller size classes of noble fir



F–496489

Noble fir has a very high form factor.

were not so numerous or vigorous as those of western hemlock. Noble fir has been observed to reproduce well under shelterwood conditions in both the Cascade and Coast Ranges. It appears the species is not as intolerant as some have indicated, especially in the younger age classes.

Noble fir generally prunes itself well in closed stands.

Principal enemies.—Insect enemies of noble fir are not serious. Only one insect, the noble fir bark beetle (*Pseudohylesinus nobilies*), commonly kills the tree. Other insects that may attack the living tree are the flatheaded fir borer (*Melanophila drummondi*), two roundheaded borers (*Tetropium* sp. and *Poliaenus oregonus*), and a twig beetle (*Pityophthorus pseudotsugae*). A bark weevil (*Pissodes piperi*) has recently been reported killing noble fir in a 90-year-old stand near Mount Hood (*9*). The stand sustained rather extensive snow break and the weevils, after breeding in these materials, attacked green trees, particularly in the intermediate and suppressed crown classes.

Balsam wooly aphid (*Chermes piceae*), which is so destructive to Pacific silver fir and subalpine fir, is known to attack noble fir (*5, 28, 32, 33*). In the greenhouse it appears as susceptible to attack as other *Abies*, including Pacific silver fir, and shows the typical reactions to attack—pathological resin flow and swelling of buds and nodal areas. In the forest it is much less susceptible, however, and may be infested but is not seriously damaged. In a survey of a 413,000-acre area around Mount St. Helens, infested heavily with aphid (*27*), noble fir constituted 50 percent of the undamaged true fir volume, 10 percent of the volume classed as lightly to moderately damaged by the aphid, and none of the volume killed or heavily damaged.

Compared with many other *Abies* species, noble fir is relatively free of important diseases. It is attacked by several trunk rot fungi including *Echinodontium tinctorium* (Indian paint fungus), *Fomes laricis* (brown trunk rot), *F. pini* (red ring rot), and *F. pinicola* (red belt fungus), and by the red brown butt rot fungi, *Polyporus schweinitzii* (*17, 30*). It is also attacked by a number of stem cankers, needle rusts, and needle casts, and by brown felt blight (*Herpotrichia nigra*), but none of these are considered serious (*6, 30*). In the southern part of its range, dwarf-mistletoe, *Arceuthobium campylopodum* forma *abietum*, attacks noble fir (*12*).

Other damaging agents are generally of minor importance. In some parts of its range, wind shake is common (*15*). It is tolerant of exposure and is very resistant to crown deformation. This is strikingly illustrated in young stands of noble fir and Douglas-fir growing along the breaks of the Columbia River Gorge, an area noted for wind deformation of trees (*22*). In Great Britain (*7, 18*), noble fir is above average in windfirmness, is very resistant to damage from snow, ice, or cold, and is more resistant to frost than grand fir or Pacific silver fir.

RACES AND HYBRIDS

No races of noble fir are known within its natural range but three horticultural varieties, *glauca*, *prostrata*, and *robustifolia*, are known. Hybridization of noble fir with Shasta red fir and California red fir probably occurs where the species overlap in southern Oregon, and hybrids have been produced with *Abies recurvata* and *A. concolor*.[5]

Revised from "Silvical Characteristics of Noble Fir," by George R. Staebler, formerly U.S. Forest Serv., Pacific Northwest Forest and Range Expt. Sta. Silvical Ser. 5, 12 pp., 1958. (With subsequent revision by Jerry F. Franklin, U.S. Forest Serv.)

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